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ESSAYS

Physiological and Practical, on the

NATURE and CIRCULATION

OF THE

BLOOD.



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PHYSIOLOGICAL and PRACTICAL,  
ON THE  
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AND THE  
EFFECTS and USES  
OF  
BLOOD-LETTING.

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By HUGH SMITH, M.D.

Physician to the Middlesex Hospital.

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LONDON:

Printed for W. JOHNSTON, in Ludgate-Street:  
MDCCCLXI.





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# P R E F A C E.

**A**S we have no remedy that is more universally recommended than Blood-letting (tho' its real effects are perhaps the least of any known and understood) it is presumed that any attempt to explain the modus operandi and uses of this evacuation upon plain and obvious principles, may meet with the approbation at least



of the younger practitioners in medicine, for whose assistance the following Essays were principally intended.

If it were known to the author that any treatise upon this subject, founded upon proper facts and a just theory, had been published, either in the English or any other language, this had never appeared, nor probably would it now have been made publick, but for the advice and encouragement of the late learned and ingenious Dr.

Stephen



Stephen Hales, to whom it was intended to have been inscribed, and whose approbation in a subject and design of this kind, was judged sufficient to hasten its execution.

As it was designed principally as a practical Essay, the physiological parts have been only introduced as tending to explain the practical.—Nor was it proposed to give a full and succinct account of the blood, but only to touch upon such of its properties

ties



ties as were necessary to illustrate and explain the succeeding doctrines: and though we are obliged to differ from the great Boerhaave in his theory of the blood, and the consequences drawn therefrom, as later experiments and observations have thrown more light upon the subject, it is not without the highest respect to the memory of a man who has so eminently deserved of the medical world.

The observations and facts relating to the motion and action of  
the



the heart, I have transcribed from that expert physician, the ingenious Dr. Whytt's Essay on the Vital and Involuntary Motions ; whose works cannot be read but with pleasure and improvement.

If I have differed from other authors in the account of a plethora and inflammation, it is not with a view of advancing a new theory, but of investigating the truth ; and if any thing more consonant to observation and facts should appear,



appear, I shall be very ready to reject any doctrines I may have advanced, to embrace more consistent opinions.

Mincing-Lane,  
March 12, 1761.

**The AUTHOR.**



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## ERRATA.

Page 25, line 13, for *movement* read *moment* ;  
page 51, line 14, for *impressed* read *oppressed* ; page  
65, line 7, for *brains* read *brain*.



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E R A T A.

Page 21, line 12, for constant read moment;  
Page 21, line 14, for neglected read applied; Page  
62, line 7, for blood read brain.



OF THE  
BLOOD.

§. 1. **T**HE fluid which is contained in the vibrating arteries, and in the veins which correspond and communicate with them, is called by the general name of blood; which, when first drawn from the body, appears to be an homogeneous liquid, but when no longer in motion through the vessels, and permitted to rest in the common temperature of the air, will gradually



dually concrete into a red tremulous coagulum.

§. 2. After some time the coagulum will be separated from the sides of the vessel the blood was received into, and a yellow coloured liquor, the serum, will ooze from the concreting substance and surround it on all sides, till increasing in quantity, the contracted mass will appear like an island swimming in the circumambient fluid.

§. 3. We have here a spontaneous separation of the blood into two parts, the cruor or crassamentum, and the serum; and these again, though they appear homogeneous, consist of different principles easily to be separated from each other.

§. 4.



§. 4. By rectified spirits, mineral acids, or any degree of heat from 150 upwards, the blood may be coagulated; as on the contrary, by putrefaction or a continuance in a warm air it may be attenuated and resolved into a foetid liquor, which will at length mostly exhale in a volatile steam, a small quantity of earthy +æces only being left behind. When the blood has been dissolved by putrefaction it cannot be again congealed or inspissated, or when coagulated by ardent spirits, nothing will resolve it.

§. 5. Chemically examined, the blood will afford the same principles as all other animal substances, as it is found to consist of phlegm or water, oils of different consistence, a volatile alkaline



salt, air, and a fixed earth; but as several of these elements cannot exist in the blood in a sound state, they must not in a strict sense be deemed its composing principles; for the acrid foetid oils and the volatile alkaline salts are creatures of the fire, and owing to chemical processes, and such a degree of heat as cannot possibly happen in an animal body.

§. 7. By the microscope several phenomena have been detected, upon which a variety of theories have been constructed, to explain the appearances both in a sound and morbid state of the blood. Leuenhoeck, who was the first that by means of glasses attempted to investigate its nature, was persuaded that in the blood, whilst circulating through the



the transparent parts of animals, or when received into a glass tube, he could readily distinguish a number of spherical globules floating in an almost transparent fluid. Some of these globules appeared larger and of a red colour, others smaller and yellow. The red globules he assigned to constitute the fibrous crassamentum, the yellow ones the serum, and the pellucid fluid they swam in, the lymph and the other thinner parts of the blood. He was even induced to believe that the large red globules were each composed of six lesser ferous ones compressed and united together; on the contrary, that by rest, or a defect of the compinging cause, the red globules would be decomposed again into their constituent ferous; so that the only dif-



ference between blood and serum consisted in a closer union of the globules of serum; that one red globule, when not sufficiently compressed by the action of the vessels, dissolves and separates into six lesser yellow ones; and that six of these when again united will form one globule of blood.

The great Boerhaave and many other ingenious physiologists have favoured the Leuenhoeckian doctrine; and indeed this hypothesis seems still to be received amongst the greater part of the professors of Medicine, as from a superficial view it will appear sufficiently plausible, but if closely examined will be found extremely deficient, and liable to great objections, as it will by no means suffice to account for the appearances in



the blood, or explain in a satisfactory manner the theory of those diseases which have been founded on this perhaps only an imaginary basis. A further enquiry then will become necessary to procure a proper knowledge and more consistent opinions upon this so material a subject.

§. 7. It has been before observed, that the blood as it cools, separates spontaneously into serum and crassamentum: the serum in weight exceeds water about a 38th part, and is about a 12th lighter than the crassamentum \*; to the taste it is slightly saline, and has an appearance something viscid from a ropy mucilage, in some measure similar to the diluted gums of vegetables: in a heat of 150

\* Haller Elementa Physiologiæ, §. CLVII.



degrees it hardens into a mass analogous to the white of an egg, which again exposed to the fire, may be separated into two parts, of which the largest appears a limpid phlegm, and the remainder becomes a fixed solid and fragile body, which bears a resemblance to horn or amber, and cannot be again dissolved in water. It is plain from the above, that the serum of the blood is composed of a viscid mucilage, dissolved and suspended in a phlegm, which is slightly impregnated with a saline principle.

§. 8. The cruor, though it has the appearance of an homogeneous mass, when examined, will afford distinct and different principles; the crassamentum, properly so called, which of itself is of a whitish or greyish colour, and a red matter,



matter, the tinging particles of the blood, on which depends its red colour. These, though they naturally attract and adhere to each other, may by various methods be obtained separate; for if new-drawn blood be continually stirred with a feather or stick till it becomes cold, a considerable quantity of a fibrous tough substance, which by washing will become white, will adhere to the stick, and the remaining part of the blood thus deprived of its thicker parts will not concrete, but separates by rest into two substances, the serum which swims uppermost, and the red tinging particles which will be precipitated towards the bottom of the vessel, but by agitation will rise again, and fluctuate in the serum. Or if blood as it flows from a wounded vessel be received into a basin  
of •



of warm water, and well mixed with it, when cold the crassamentum may be separated from the aqueous parts, of a whitish or greyish colour lightly tinged with red: the fluid remaining in the basin appears thin, and of a very florid red colour, as consisting only of the serum and tinging particles of the blood, mixed and united with the water. Or again, if the cruor be repeatedly washed with cold water it parts with its red colour, and then appears a fibrous, light-coloured substance, something similar to the coagulated serum: the red particles diffused through the water will tinge it with their colour, though the same water cannot be made to wash them out beyond a certain proportion, sufficient to convert it into a bright red tincture, which upon standing does not precipitate



tate its colour, much less will there appear any inclination to yellowness or resemblance to serum.

Will not this be sufficient to contradict the received opinion, that the red globules are owing to six yellow ones united; or that upon the resolution or attenuation of a red globule, it will be converted into serum? Certainly the principles of the serum and crassamentum are different, and must vary in other respects, than in a greater or lesser degree of condensation in the globules; neither is it credible, that by the contraction of a blood-vessel it can be possessed of a faculty of uniting the exact number of six into one; or can it be proved that one red globule was ever resolved into six yellow ones.



§. 9. From the above observations and experiments it is plain, that the blood is composed of three parts, distinct and differing from each other, the aqueo saline, the glutinous, and the red globular; to the first of which the fluidity, to the second the consistence, and to the third the colour of the blood is owing. These, however different in their several natures in a sound state, are kept equally mixed by the vital motion and circulation of the blood, though they cannot intimately cohere, or be united into an homogeneous fluid.

§. 10. From the principles above premised, may we not be able to form some judgment as to the nature and rise of the globules, which by the microscope have been supposed to have been  
detected



detected in the mass of blood? We certainly can, and may easily explain the several phenomena, in a manner at least as satisfactory as by having recourse to Leuenhoeck's union and resolution of globules. The red globules may swim in, and be discerned separately from the aqueous serum, between which there is naturally a repulsion, and as perhaps the circulating powers can only attenuate and divide them to a determinate degree, they will appear nearly of the same size; their spherical figure will depend upon the cohesion of the particles, between which the serum will be interposed, and with which they will not unite; and as they are soft and compressible, will easily change their form when acted upon by the vessels; and again when freed from pressure, will put on the globular



bular appearance, or when at rest, and no longer kept mixed by the motion and circulation of the blood, will form a mass with the crassamentum, and leave the serum free from redness. Something similar to this may be observed in a mixture of oil with water; these by agitation appear to unite, but when at rest, the oily particles attract each other and separate from the water.

That the red globules from particular causes may be divisible is not improbable, and when divided they may appear of a fainter colour; but it is greatly to be doubted whether they always separate into six or any other determinate number: but nothing is more incredible, than that by this separation the red globules should be converted to serum, or  
that



that by the adunation of fix ferous globules a red one should be formed : It is repugnant to experiment, and must be impossible, from the several and different natures of the serum and crassamentum. A speculative physiologist may indulge these kinds of hypotheses, but pathology cannot be benefited thereby.

§. 11. The crassamentum of the blood should appear to be the most consummate and elaborate part of the animal humours, and to be the result of strong and sound vessels and viscera, since it always most abounds in healthy robust people, where the circulation is vigorous, and the action of the vessels performed with power and strength : on the contrary, is  
much



much deficient in the weakly and infirm, where the circulation is languid, and the vital powers flag. It should hence seem that there is a reciprocal action between a dense thick blood and strong vigorous solids, as an excited circulation will always tend to condense the fluids ; and again, where the fluids are of a due consistence, the strength and action of the solids will be rarely deficient. A diminution of the crassamentum, by excessive hæmorrhages, greatly weakens the body and relaxes the solids, and cannot be again but gradually repaired ; or if the constitution should be too much debilitated, it frequently happens that the solids will not be possessed of a due degree of energy to work up the fluids to a sufficient density for the continu-

ance



ance of health, and the patient will soon become hydropic, or languish under a general weakness, to be only relieved by confirming the solids and condensing the fluids.

§. 12. What may be the standard proportion of the different principles of the blood to each other seems difficult to determine, as it will admit of considerable variation, without injury to health, in different ages, sexes, temperaments, &c. so that a general rule can scarcely be established. It frequently, however, happens, that, from an excess of one or the other, various and different diseases will be produced; for if the fibrous crassamentum is too



to the serum, diseases from a plethora must be the consequence ; as on the contrary, when the serum superabounds, dropfies, cachexies, and other complaints from a colluvies serosa will ensue.

§. 13. The quantity of blood in general contained in the human body has not as yet perhaps been ascertained ; but it is obvious, that the weight of the fluid considerably exceeds that of the solid parts, though many of them, as the connecting gluden, the fat, and the like, are not regularly circulated thro' the vessels of the body : but if we may be allowed to make any guess from hæmorrhages which have happened without the loss of life, and from experiments made on living animals purpose-

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ly



ly exhausted of their blood, compared with the bulk and capacity of the veins and arteries, the mass of circulating humours in a middle sized man, must be equal at least to fifty pounds, of which the arteries contain about a fifth part, and the veins the remaining four\*.

§. 14. From the blood all the different juices of the body are secreted, which for that purpose, and lest it should coagulate and corrupt by stagnation, is in perpetual motion throughout every part of the body. With this progressive motion and the manner in which it was performed the ancients were unacquainted; the honour of the discovery was reserved for our countryman, the great, the im-

\* Halleri Elementa Physiologiæ, §. CLXVII.



mortal Dr. Harvey, who about the year 1619, first made public and explained this important doctrine: from his demonstrations it was plain that an animal body was an hydraulic machine, all whose offices are entirely dependant upon the circulation of the blood, which cannot for any time (even a few minutes only) be suppressed without its necessary and consequent destruction.

§. 15. The blood in its progressive motion is conveyed from the heart by the arteries, to all; even the minutest parts of the body; from thence being brought back again by the veins, and collected in the sinus venosus, it is protruded into the right or superior auricle and ventricle; from the right ventricle of the heart it is forced into the pulmonary



monary artery, and after circulating through, and being acted upon by the lungs in its passage through them, is returned by the pulmonary vein into the left or inferior auricle and ventricle; from the left ventricle it is expelled into the aorta, by whose converging branches it is transported into all parts of the body, and at length being transmitted from the extremities of the small arteries into the nascent or incipient veins, thro' them passes into their larger branches, till it arrives at their termination, the heart, from whence it is as before discharged into the arterial system, again in a perpetual round, to traverse the body.

§. 16. It has been disputed amongst authors, to what causes the alternate contractions and relaxations of the heart



could be owing, and by what powers the blood with an incessant motion is circulated through the body : their hypotheses have been very different and vague, not to say some of them very absurd, till the learned and ingenious Dr. Whytt of Edinburgh, some few years since favoured the world with a satisfactory theory on that head, founded upon experiment and supported by reason, which fully answers to, and explains all the phænomena of the heart's motion, upon principles as simple as they are agreeable to the known laws of the animal œconomy \*.

The doctor, after premising some facts concerning the actions of the

\* Whytt's Essay on the vital and involuntary motions.



muscles, and their proneness to contraction, from a stimulus, or any thing which will irritate, being applied to them, accounts for the contraction or systole of the heart, from the stimulus applied to, and the distension of this hollow muscle, by the venous blood returning into the cavæ from the different parts of the body ; and this he proves to be extremely well fitted to act in this manner upon the heart, from its composition, heat, intestine motion, the qualities it may probably receive from the air, and the force with which it rushes into its cavities.

From the irritation then communicated to the ventricles of the heart, and the distention of it's cavities by the

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blood,



blood, each of which may under particular circumstances promote and influence its contraction, we may easily account for the constant and reiterated motions of this organ ; and this of all the theories that have been hitherto offered, will best explain the several phænomena of the heart's action, and indeed appears in all respects satisfactory and conclusive. “ Whilst some authors  
 “ (says the doctor) have ascribed the  
 “ contraction of the heart solely to the  
 “ blood, considered as a stimulating  
 “ fluid, which irritates the internal surface of its ventricles ; others have  
 “ been unwilling to allow that the blood  
 “ acts in any other sense as a stimulus  
 “ upon the heart, than as by its weight  
 “ and impulsive force it stretches and  
 distorts



“distracts the fibres composing its ven-  
 “tricles; but the increased motion of  
 “the blood from the contagion of the  
 “small pox, measles, and the like,  
 “and after eating and drinking any  
 “thing acrid, as well as the power  
 “which acrid and stimulating things  
 “have in renewing the heart’s motion  
 “after it is separated from the body,  
 “are circumstances which shew that  
 “the contraction of the heart is not  
 “solely owing to its fibres being dis-  
 “tracted by the moment of the blood,  
 “but partly to the irritation communi-  
 “cated to its internal surface by the  
 “particles of this fluid. On the other  
 “hand, the increase of the heart’s mo-  
 “tion from exercise, or from any other  
 “cause whence the blood is returned  
 “in greater quantity and with more  
 “force



“ force to the heart, its diminution by  
 “ blood-letting, the phenomena of the  
 “ motion of the stomach, and of the  
 “ expulsion of the urine and fæces ; all  
 “ these particulars prove, that even the  
 “ distention of hollow muscles has a  
 “ remarkable influence towards excit-  
 “ ing them into action.”

It will appear then, that the blood  
 returning by the cavæ and pulmonary  
 veins, and rushing into the cavities of  
 the heart, will in such manner stimulate  
 and affect its sensible nerves and fibres,  
 as to bring it immediately into contrac-  
 tion : if the blood should by any means  
 have been rendered acrid, as from in-  
 fectious miasmata, an impeded excre-  
 tion of the acrimonious perspirable par-  
 ticles,



ticles, an absorb'd purulent matter, or the like, by its increased stimulus it will excite the heart to quicker vibrations, and febrile symptoms must come on. Or again, by heat or exercise of the body, which rarify the blood, and cause it to be determined more copiously to the heart; the cavities being distended, its contractions will be more frequently repeated, and the contained fluids expelled with more force, and circulated with an increased velocity thro' the body.

§. 17. The systole, or contraction of the heart, is immediately followed by its relaxation or diastole; for the ventricles by their action having expelled the blood which they contained into the aorta and pulmonary arteries, their component  
fibres



fibres will necessarily lose that tension and firmness which the moment before they were possessed of. At this time the contraction of the arteries begins; for the blood being expelled from the heart with a force which considerably exceeds the resistance they can yield, will dilate them, distract their fibres, and perhaps slightly stimulate their internal superficies: this their dilatation, and the change from a less to that of a greater capacity thereby occasioned, is called the pulse, the diastole of which is an expansion of the artery beyond its natural circumference.

The arteries thus distended and irritated by the stimulus of the forcibly impelled blood, from an inherent contractile



tractile power, which is natural and common to them, as consisting of circular elastic fibres, are immediately again constringed, and return to their former diameters, by expressing a quantity of blood into the venous system, proportionable to that with which they had been dilated beyond their ordinary capacity ; and the arteries by this means being disengaged from the wave of blood emitted from the ventricles, the distention and stimulus thereby occasioned will cease, till they are again overstretched by the blood protruded into them at each systole of the heart, in consequence of which they are again excited to contract themselves. And this alternate motion and contraction must continue whilst life and the circulation of the blood endure.

From



From the above it will appear, that from the pulse we shall be able with a good deal of certainty to form a proper judgment as to the true state of the circulating powers : a full, strong pulse will denote that the blood abounds in the body, and that it is expelled in large quantities at each contraction of the heart, into the arterial system : as on the contrary, a weak languid pulse will evince that the blood does not exceed in quantity, nor is it circulated with too great an impetuosity through the body. A quick and strong pulse will argue that there is a disposition to a plethora, at the same time a stimulus, to excite to more repeated contractions the circulating powers ; as a quick and weak pulse will prove that there



there is rather a deficiency in the quantity and consistence of the fluids; but at the same time a stimulating acrimony, or a disposition to irritability in the solids themselves, beyond the necessary bounds.

§. 18. The actions of the heart and blood-vessels will variously affect the circulating fluids, as they are performed with a greater or lesser degree of strength and elasticity. It is to these that we are indebted for the conversion of chyle into milk, and at length into blood; and this will vary in its density and principles, according to the strength or weakness of the system of the solids, and as the circulation is performed with more or less vigour. The strong elastic vessels act forcibly upon their contained fluids,



fluids, whence a greater friction and attrition of the blood and vessels against each other, an increased heat and dissipation of the more watery particles, the crassamentum is wrought up to a higher degree of density, and abounds in full proportion to the ferous parts.

The blood and juices of people in such a constitution become for this reason more dense, compact, and viscid, which will be manifested by examining the blood of a robust man who uses much exercise, which always will appear of this kind.

Even in diseases in which the vital actions are too much encreased, as in ardent fevers and inflammatory diseases, the mass of blood is soon rendered dense



and tenacious, and covered with a phlogistic lentor.

On the contrary, where the vessels are too weak, and the circulation languid, the fluids of the body cannot be sufficiently acted upon, or worked up to a due degree of density and a proper consistence, whence the blood has the appearance of a dissolved watery fluid, not sufficiently prepared for the strength and nourishment of the body, or the purposes of the animal œconomy, nor circulated with a force sufficient to preserve and maintain the vital heat. And hence arises a pituitous lentor in the serum, which under these circumstances is not sufficiently attenuated, or its particles divided ; whence concretions in the vessels, cachexies, leucophleg-

D

matix,



matiaë, and innumerable other complaints. In diseases likewise in which the vital actions are depressed, the pulse is small and weak, the heat of the body lessened, and the texture of the blood dissolved, with a superabundant quantity of serum.

§. 19. To the circulation of the blood rightly and æquably performed, we are indebted for life, health, and at last a gradual decay or old age. But if by any means the blood in its rotatory motion should be impeded or disturbed, it will become the fruitful cause and mother of diseases and death. So long as the blood and humours are circulated through the ducts and canals of the body, an animal will live ; but no sooner does the circulation cease and  
become



become extinguished, than death succeeds to life. If the circulation thro' every part should be performed freely, æquably, moderately and agreeably, so long we remain sound and healthy ; but in every disease we find the circulation too much encreased, decreased, immoderate or unequal ; and morbidic causes are in a great measure productive of diseases, by disturbing and impeding the œconomy of the vital motions, and perverting the secretions and excretions.

§. 20. Thus far it hath been thought necessary to premise, that the succeeding doctrines of the effects and uses of blood-letting may more readily be comprehended and understood.



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OF THE  
GENERAL EFFECTS  
OF  
BLOOD-LETTING.

§. 21. **T**HE circulating powers according to particular circumstances will be variously affected by an evacuation of blood, as sometimes in a plethora, where the vessels are too much distended, a moderate blood-letting will tend greatly to promote the free and easy motion of the fluids. On the contrary, we know of no remedy that will so speedily weaken the powers of nature and impetus of the circulation, and produce so immediate and universal a weakness. We shall be at  
no



no loss to explain from the preceding observations in what manner these effects can be produced, at the same time may establish the doctrine and uses of blood-letting upon plain, easy, and indisputable principles.

§. 22. The ventricles of the heart, it has been observed (§. 16.) are dilated and excited into contraction by the returning venous blood ; and by the œconomy of the circulation, the quantity expelled into the arteries at each systole or contraction will bear an exact and constant proportion to that which enters into, and dilates the cavities in its diastole ; and this will be greater or less, according as the blood more or less abounds in the body.

In proportion then as the circulating fluids are diminished or evacuated, the



quantity to be received by the heart in its diastole must be lessened ; in consequence of which, the quantity to be distributed by the arteries to the different parts of the body must likewise be diminished, and every artery will become less full and distended according to its size and capacity. Hence we find, that after a copious phlebotomy, the pulse becomes softer and easier, and the heat, tension, and compression of the several parts of the body equally remit in proportion to the evacuation which may have been made : hence likewise, as the resistance to the contraction of the arteries is in part taken off, and the moles movenda lessened, the remaining blood will be more readily subservient to the impulsive force of the arteries, which now will contract themselves  
more



more easily and readily, and hasten the circulation of their contained fluids. And this will be exemplified in diseases from a plethora, where the arterial tubes are often so much distended as greatly to be impaired in their tone and elastic force ; so that they become unable rightly to perform their contractions, or circulate the blood through the body ; but no sooner is the distending cause removed by a copious phlebotomy, than the vessels recover their elasticity ; and by their free and easy contractions, push forwards the circulating humours, by which the progressive motion of the blood, and the several functions of the body, before oppressed and suffocated, are now again restored.

§. 23. Though blood-letting in a plethora, and under particular circum-



stances, may contribute so greatly to restore the motion and action of the vessels, when distended beyond their tone of contraction; yet on the contrary, it is of all others the most speedy remedy to weaken and destroy the action and elasticity of the vessels, and to produce an immediate and universal weakness; for as the influx of the blood into the cavities of the heart appears to be the cause which excites it to action (§. 16.) it must follow, that when the vital fluid is exhausted, the quantity to be returned to the heart will be lessened: whence the strength of its muscular contraction will be impaired; the reaction of the arteries, now not sufficiently distended, will be abated; the circulating powers will flag, and  
 may



may be reduced to any degree at pleasure.

§. 24. As bleeding weakens and destroys the action of the vessels and organical parts, upon the same account it lessens the heat of the body and the motion and impetus of the blood throughout the whole vascular system: for as the friction and attrition of the fluids against the solids are a chief cause of heat in the living animal, which is constantly augmented as the motion of the humours through the vessels is increased, and again will gradually decrease as the motion and impetus are lessened; it is evident, that by evacuating and taking away the cause which would excite the heart to action, the force and strength of its muscular contraction may to any degree



degree whatever be diminished ; nay, we can at pleasure by blood-letting alone reduce so far the motion and impetus of the humours, and give so great a check to life and the circulation, when too impetuous or beyond measure excited in acute diseases, as to induce a general languor, and by protracting the evacuation, can bring on a deliquium animi, or even death itself, by which both heat and motion will most effectually be stopped and cease.

Galen has related a case of a young man who was so immediately relieved in an acute fever by a copious phlebotomy, that a person present exclaimed, “ O homo jugulaſti febrim \*.” By ex-

\* Galen. Method. Medend.



periment it has likewise been demonstrated, that by these means the circulating powers may to any degree be weakened. The ingenious Dr. Hales, by adapting glass tubes to the vessels of living animals, could remark the height the blood, as propell'd by the force of the heart and arteries, would ascend to in the tube: he observed, that in proportion as he evacuated the blood from the body, the actions of the arteries became gradually weaker, and the ascent in the tube more and more lessened, till at length the powers of life unable with a due degree of force to propel and push forwards the fluids, the animal of consequence expired \*. It will appear

† Hæmistatics, Experiment 1, 2, &c.

then



then that by blood-letting, the action of the heart and arteries, the motion and impetus of the blood, and with them the heat of the body, may to any degree at pleasure be diminished.

§. 25. Let us next examine the effects of blood-letting upon the fluids; and these it will appear will be principally to attenuate and thin them, and this it may effect in a twofold manner: as 1st, from the change superinduced upon the solids; and 2dly, from a diminution of the crassamentum, the thickest and most elaborate part of the animal fluids. As the condition of the fluids in a great measure depends upon that of the solids, whether their actions are more or less excited (§. 18.)

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it follows, that where the circulating powers are weakened, the blood must soon be rendered thinner, as it cannot be worked up to that degree of density consequent to a strong and vigorous circulation. Again, by an evacuation of the cruor or crassamentum, the thickest and most consummate part of our humours (§. 11.) many of the effects produced by blood-letting are to be accounted for, which we should be at a loss to explain from the depletion of the vessels only; since from the aliments they may soon be again filled, and would be distended as much as before. But where the cruor superabounds in the body, the blood will become too thick, its fibrous parts will bear too great a proportion to its serous, and it is with  
difficulty



difficulty it can be circulated through the smaller vessels; whence obstructions, stagnations, compressions, an impediment to the exit of the blood from the arterial into the venal system, ruptures of the vessels, suffocation and death. But if we diminish the quantity of the mass of blood, a considerable portion of the thicker parts will be evacuated, the remainder will be rendered more thin and ferous, and readily circulated through the smaller vessels; nor can the loss of the cruor be immediately repaired from the aliments, as there will be required the repeated actions of the vessels in innumerable circulations through the body.

§. 26. From what has been above observed, it will appear obvious what effects



effects are necessarily consequent to an evacuation of blood, and these can only be the following : in a plethora a moderate blood-letting must tend to deplete and free the vessels and organical parts when over distended with a thick, dense blood, by which means it promotes and encreases the circulation of the fluids, the easy, free contraction of the arteries, and the elasticity of the vessels, at the same time conduces to the attrition, attenuation and motion of the blood ; hence restores the natural and ready exercise of the functions of the body, depraved by a superabundant quantity of humours distending the vessels and clogging the circulation, and by those means relieves in many and various diseases, and



and produces great changes in the animal œconomy.

Again, the same remedy will prove of all others the most speedy and efficacious to weaken the action and elasticity of the heart and arteries, and to lower the impetus of the circulation: hence in acute inflammatory diseases, where the blood is too rapidly and impetuously propelled, will afford an immediate and speedy relief; but if profusely, injudiciously or unseasonably used, where there is neither a real plethora or encreased impetus of the circulation, by lowering the vis vitæ, will retard the cure of many diseases, at the same time greatly relaxes the solids and lessens the heat of the body, retards the circulation,

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tion, diminishes the strength, dissolves and thins the fluids, and produces leucophlegmatias, dropfies, and innumerable other evils; whence the body becomes weak, infirm, and cachectic.

§. 27. *Can blood-letting be of any service in those disorders which immediately owe their origin to a fault, either in the solid or fluid parts, as considered absolutely in themselves?* It should seem not: we cannot by its use add strength to weakened or relaxed solids, or soften the fibres when they become too rigid; neither in diseases from a vicious constitution of the humours, will the redundant or contaminated particles alone be expelled, as such a proportion only of the morbid matter can be evacuated, as the quantity of blood drawn away bears to the whole



mafs of humours: fo that we can nei-  
 ther expect that the vitiated particles  
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 conclude, that blood-letting is princi-  
 pally to be recommended in thofe cafes  
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 folids and fluids is destroyed by too  
 great a quantity, or too denfe a con-  
 fiftence of the blood impeding the due  
 and regular action of the veffels; or  
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 ing too much increafed, and the cir-  
 culating powers beyond proper bounds  
 excited, pervert and deftroy the feveral  
 functions of the body.



§. 28. *Have we any certain criterion to judge when it may be proper to recommend the use of this evacuation?* The pulse will be our best and surest guide, if we attend to that, we may readily judge of the true state of the circulating powers. In every disease where the pulse is full, strong, or tense, we may be sure that blood-letting will be indicated, as it proves that there is either a real plethora or too encreased an impetus of the circulation. In some cases we should be cautious that we are not deceived by an **oppressed** pulse from an over-distention of the arteries, which, as it is a true sign of a plethora, will be relieved, and the pulse will immediately rise from the evacuation. Again, in old people, where the cir-

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culation



gulation is not too much increased, the pulse will frequently be hard and tense, from a rigidity of the coats of the arteries, not to be removed by blood-letting. For the most part however we shall not easily err if we attend to the pulse, which, if either full or tense, will indicate that the lancet may be advantageously recommended. But if the pulse should be neither full, strong, or oppressed, it will plainly prove that the vessels are by no means over-distended, or the circulating powers beyond measure excited: why then should we evacuate where the fluids do not too much abound? or why should we sink the pulse and lessen the action of the heart and arteries, when they were not before too much increased.



§. 29. *Are we to attribute any particular effects to the revulsive or derivative blood-lettings so much practised and recommended by the ancients?* The ancients were greatly mistaken, and differed much from the moderns in their theories of the blood; nor are we to wonder that their doctrines should be erroneous, and built upon a wrong foundation, as wanting our later discoveries to ascertain and rectify their physiological conjectures. Being ignorant of the functions and offices of some of the principal viscera, of the circulation of the blood, and action and uses of the heart and arteries, we shall not be surprised to find them guilty of many absurdities in their theory and practice of blood-letting. Accordingly



it appears that they were very superstitious in their election of vessels, as they supposed that there was an attraction of the mass of blood towards the orifice in blood-letting; hence allotted to every part its particular vein, which they imagined must communicate with it, and which it would have been the highest mal-practice not to have opened whenever it should be diseased. When the head was affected, the upper or external vein of the arm, thence termed the cephalic, was to be opened; when the noble parts or viscera were diseased, the internal, thence called the basilic, was chosen; and if it should have appeared necessary to bleed for the relief of both together, the vena mediana, which they supposed to communicate with each,

was



was then the vessel that was fixed upon, and so on of the others. And this their practice seems to have given rise to the noted doctrine of revulsion and derivation, which for so many ages has prevailed amongst the practitioners of medicine, and laid the foundation for numerous and almost endless disputes. As our forefathers were ignorant of the circulation of the blood, and had not the advantages from anatomy and natural philosophy as are at present enjoyed; well might their theories and reasonings be absurd and whimsical, but it is matter of surprize, that the effects of revulsive or derivative blood-lettings should not yet have been ascertained by our modern physicians, or the question decided, whether or no it is material



from what vein or part of the body our evacuation should be made in different diseases. It is foreign to my purpose to enter into the dispute, or take notice of the arguments in favour of revulsion, derivation, or both, since it seems most probable that the effects which they attribute to their revulsive or derivative blood-lettings, are entirely owing to the evacuation alone, and upon that principle may be satisfactorily explained, without regard to the part or vein it is made from; as where there are real indications for the evacuation, it is not at all material from whence it may be made: on the contrary, if the vessels are neither too full, nor the circulation too much excited from what part soever we may draw blood,



blood, we shall rather do harm than good.

§. 30. *Is there any determined quantity of blood necessary to be drawn off in particular diseases?* This depends entirely upon the habit, strength and constitution of body, and the urgency of the symptoms; a great disease requires a great remedy. The pulse and mitigation of the symptoms will however generally prove sufficient, and our best guides; when these are properly reduced and brought to due bounds, we may be pretty well assured that this remedy has been sufficiently insisted upon; sometimes a few ounces may suffice, at other times some pounds may be required to answer a proper indication, though for the most part it may not be



be amiss to stop rather short as to quantity, than too much to protract the evacuation; as we can easily repeat the operation, and have it at any time in our power to sink the pulse, when it will not always be in our power to raise it again.

§. 31. *Are frequent blood-lettings without an apparent reason necessary for the preservation of health or prevention of diseases?*

It is a common practice with many to accustom themselves to bleed once or twice in a year, with an intention of confirming their health and preventing diseases; but certainly they are often mistaken in their views, and more frequently prejudice than benefit themselves thereby. By observation we are taught that those  
who



who have been accustomed to a loss of blood, provided it be not so profuse as too much to weaken the body, will the sooner be again liable to an overfullness, though their habit of body will become considerably more relaxed. Women by the laws of nature suffer a monthly evacuation of blood, and monthly are they again filled and disposed for the discharge. Men who have accustomed themselves to repeated blood-lettings about the usual time, will labour under nearly the same complaints as women from obstructed menses, till at length their natural robustness will degenerate into female delicacy. Hence as custom may be compared to a second nature, they will be obliged to continue the evacuation till they may considerably weaken



weaken and impair the constitution, and render themselves obnoxious to many and various diseases. However, if there should appear to be real causes for the evacuation, it must be complied with, although it were certainly better not to repeat it upon every trifling occasion.

From what has been above premised as to the effects of blood-letting, it will be plain what are the intentions of cure it will answer, and under what circumstances its use can be required. We proceed to the doctrine of a plethora and inflammation, those morbid affections in which it is most immediately useful.



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P L E T H O R A.

**F**ROM a view of the general effects of blood-letting, we are led to the particular indications in which it can be required; and these it will appear can be only twofold, as first in the diseases from a true plethora where the vessels are overfilled with a thick dense blood; or secondly, in those affections where the impetus of the circulation is beyond due bounds excited, as is for the most part the case in the acute fever and other inflammatory complaints.



§. 32. A plethora has been supposed to consist in a preternatural fullness and distention of the sanguineous vessels, from so great and encreased a quantity of blood as will not suffer the machine to bear those changes and accidents inevitable to life, without inducing diseases, and those of the most acute and dangerous kinds.

§. 33. This affection, which considered in itself is a manifest proof of a good constitution, generally happens to those whose circulating powers, vessels and viscera are sound and strong, and their functions performed with vigour; especially if a greater quantity of nutritious aliments should have been indulged in than suffices for the nourishment of the body and the preservation



servation of life; or it may happen from a suppression of a natural, or a neglect of an accustomed artificial evacuation of blood; since by observation we are taught, that custom is a second nature, and that those who have been habituated to a discharge of blood about the usual time, will labour under all the symptoms of too great a fullness.

§. 34. It has been believed that the phenomena in plethoric cases arise from too great and increased a quantity of the blood and juices in general; but from a more minute enquiry it will perhaps appear that this cannot be the case, since from the aliments the food and drink, the loss of humours would be almost immediately repaired, and the  
vessels



vessels repleted and distended as much as before ; consequently a new blood-letting must be again required, which it would be necessary to repeat as often as an encreased quantity of aliments should be received into the body.

§. 35. It is much more probable that the phenomena in plethoric cases are the consequents of the fibrous crassamentum, or thicker parts of the blood abounding in an over-proportion to the serous or thinner. From an excess in the quantity of the fibrous parts, the blood becoming too thick and dense, can with difficulty be circulated through the smaller and minute vessels, or propelled from the extremities of the arterial into the venous system ; whence a  
distention



distention and dilatation of the arteries, an impediment to the free, easy, and ready circulation of the blood, an increased resistance to the force and action of the heart, ruptures of the vessels, especially in those parts where they are most fine and tender, as in the brain and lungs, obstructions, compressions, hæmorrhages, vertigo's, apoplexies, and even death itself.

§. 36. It will appear still more manifest that the above is the most palpable conjecture, if we attend to the circumstances previous to this affection, and remark the constitutions most obnoxious to it. It has ever been observed, that the most healthy and robust are the most liable to diseases from



a plethora; as here from the strong and vigorous circulation and action of the solids upon the fluids, the blood will be thickened, and the crassamentum will greatly abound. (§. 18.) On the contrary, in the weak and infirm, from the languid circulation, and debilitated action of the solids upon the fluids, the juices will not be duly elaborated, or worked up to a proper degree of density, the thinner parts will bear too great a proportion to the thicker; and though the vessels may be sufficiently full and distended with this thin and watery blood, yet it never happens that the diseases from a real plethora are induced, or are their maladies to be relieved by blood-letting.



§. 37. It should seem then that the symptoms in a plethora will not depend so much upon an encreased quantity, as upon the quality of the fluids; a dense rich blood will always predispose to plethoric affections, whilst a thin and watery state of the juices will be productive of diseases of a very different and opposite kind. We may hence readily understand why other, though more plentiful, evacuations cannot always supply the place of blood-letting; why too great a loss of blood, or rather of its crassamentum, so much thins and attenuates the remaining mass, and diminishes the heat and strength of the body; and why an evacuation of blood becomes so prompt and speedy a remedy in most diseases which



owe their origin to a true plethora, while on the contrary in a cacochymia, leucophlegmatia, or where the vessels are filled and distended with crude and watery juices, it becomes not only useless but very injurious.

§. 38. The cure of a plethora will be obvious from its causes and effects; for since too dense and rich a state of the blood will prove the occasion of the several symptoms in plethoric cases, whatsoever can thin and attenuate the mass of fluids and relax the solids, must prove beneficial: hence the best and quickest relief will ensue from a copious blood-letting, which almost immediately relieves and removes the cause. By this evacuation a considerable portion



tion of the dense crassamentum being drawn off, the remainder will be rendered more thin and ferous; (§. 25.) the action of the vessels and circulation through the body will become regular and equable, by which means its several functions will be duely and properly performed, and health again restored.

§. 39. After blood-letting likewise the several secretions and excretions, as of blood, urine, sweat, and the like, will succeed better and more freely in the plethoric than before; as from too dense a state of the blood, the extremities of the secreting and exhaling arteries will be obstructed and compressed, and their several secretions retarded; but by depleting the vessels, the circulation will be promoted, the blood will



become more fluid and attenuated, and more freely and largely circulated thro' and about the different emunctories, to suffer a secretion. Hence in the menstrual suppressions of plethoric women, by opening a vein the evacuation has soon after spontaneously returned; and hence in the inflammatory fever, a copious sweat, not to be before excited, readily breaks out.

§. 40. The volatile alkaline salts have been supposed to be possessed of a property of dissolving the crassamentum of the blood; for which reason, after phlebotomy they may be of service in plethoric cases. Lenient purgatives, the neutral salts, and plenty of warm diluting liquors may likewise have their  
advan-



advantage. We may afterwards prevent a future plethora by a spare and moderate diet, exercise of body, and a proper regulation of the non-naturals; and should gradually omit the use of accustomed artificial evacuations, that at length they may without danger be entirely left off, and the body continued in a sound and healthy state without their use.



OF

## INFLAMMATION.

§. 41. **W**E proceed to the doctrine of inflammation, than which there is perhaps none of more avail to the practice of physick, or with which the physician ought to be better acquainted, as it comprehends the theory and general method of treatment of the greater part of our acute febrile diseases, such as pleurisy, phrensy, peripneumony, quinsy, and the like: these, as being owing to the same general causes, will require nearly the same cure; some little regard being at the  
 same



same time had to the part affected, its functions and uses. The doctrine of inflammation then, when explained and understood, will readily lead us to an acquaintance with the nature, causes, and cure of the inflammatory complaints of every kind so frequently to be met with in practice.

§. 42. An inflammation, phlegmone, or phlogosis, so called from fire or heat, a principal and constant symptom, may be defined a resplendent tumour of a red colour, hardly yielding to the pressure of the finger, attended with an acute pungent throbbing pain, great heat and pulsation, and for the most part with a hard tense pulse, an encreased circulation, a fever and its symptoms, such as thirst, heat, watchings, weakness, anxiety, and the like.

§. 43.



§. 43. It may attack any parts of the body, either the external or internal; but perhaps the cellular membranes are the most common and frequent, or indeed the only seat of the disease, though the cause may be infixed in an adjacent tendinous or membranous expansion.

§. 44. A variety of opinions have prevailed, and authors have considerably varied from each other as to the proximate causes of inflammation. Boerhaave has supposed that it proceeds from a stagnation of the red arterial blood obstructing the minute canals, and more firmly impacted by the pressure and attrition of the remaining mass, agitated by a concomitant fever\*. Dr. Whytt

\* Aphorism, 371.



gives it as his opinion, that an inflammation is not owing to an encreased force of the heart and arteries consequent upon an obstruction, as some authors of great name have imagined, but to an encreased oscillatory motion in the small vessels ; whether this arises from some obstructing matter distracting their fibres, or acrid matter irritating them. An obstruction without an irritation in the obstructed part, never occasions an inflammation ; but the irritation of any sensible part with a sharp instrument or acrid matter, never fails to produce this effect, although there be no preceding obstruction or increase of the heart's force \*. Dr. Haller has

\* Whytt's Physiological Essays.



hinted, that it appears the most probable, that the greater part of our inflammations are not owing to blood impacted in the vessels, but to its exudation into the circumjacent cellular membranes; hence supposes that the cause of inflammation is entirely different from obstruction, whether it may happen from a stimulus, or, as perhaps may be the case, the nature of this affection should not as yet have been sufficiently ascertained \*.

§. 45. With respect to these hypotheses, we shall take the liberty to remark what in each appears most palpable, and how far they are liable to objection.

\* Haller. Element. Physiologiæ, tom I. pag. 115, 116.



The Boerhaavian doctrine of obstruction, though it has been adopted for near forty years by the greater part of physicians throughout Europe, appears by no means sufficient to account for the several phenomena of inflammation. It certainly is elegant, but devoid of a real foundation ; nay, should it even be granted to exist, will not suffice to explain the effects which have been attributed to it, as the consequents of inflammation have in this case been always mistaken for the cause. It has been supposed by the advocates for this doctrine, that an inflammation depended upon an obstruction of the smaller ferrous arteries from the red globules of blood passing into, and being detained there : this they call an obstruction from  
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an error loci. These vessels, which they believed were conical, and in a natural state conveyed the ferous and thinner particles of the fluids only, might from different causes so far suffer a distraction at their origin, as to admit the red globules of blood into their dilated orifices; but at the same time would oppose a resistance to their progress as they were propelled forwards, and still more as they advanced towards the extremities of the vessels; whilst the blood circulating in the adjacent arteries, being by the action of the heart and arteries continually urged forwards upon the obstructing particles, they by these means become still more firmly impacted in the straitened passage. And hence they would account for the

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cause



cause and signs of inflammation. The minute, pellucid, and scarce visible arteries becoming obstructed, are by the distending blood enlarged and rendered visible, and give rise to the red tumour. The vessels over-distended and nearly burst, will be the occasion of the pungent pain; and from the irritated fibres and quickened circulation thro' the pervious vessels, the pulse becomes more frequent, a fever comes on, with thirst, heat, weakness, watchings, and the like. And unless the obstructing matter should be repelled from the minute serous into the sanguineous arteries, or be separated into smaller moleculæ; so that they might pass thro' the extremities of the vessels, the over-distended canals would at length necessarily burst, as there could otherwise



wise be no exit to the obstructing globules.

As they believed that a red globule was composed of six ferous united, and a ferous globule of six lymphatic, so they have further supposed that in the same manner as the ferous vessels arise from the minute sanguineous, other finer vessels were branching off from the ferous, neither was there yet a stop to the progression, or was the ultimate class of vessels known.

And hence they have still further imagined, that new errores loci, and inflammations which would not appear of a red, but of a yellow colour, might arise as often as the yellow fluid of the ferous arteries was impelled into  
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the pellucid lymphatic vessels and detained there; whence erysipelatous inflammations and various other affections.

It remains that we examine how far the above elegant and specious theory will be found true.

That there are vessels which naturally do not appear to circulate the red blood, no one can deny; for of this the fabric of the eye alone affords sufficient proof: but it does not follow that they can become obstructed from an error loci, since it is certain that the principal argument on which this theory is founded is destitute of a true foundation: for as Dr. Haller has observed, although these vessels which are naturally pellucid and indiscernible, when injected with a tinged liquid, or



over distended with blood, will appear red and become conspicuous, it does not amount to a proof that they were before impervious to the red globules, or that they are of a different kind to the red sanguineous ; since it has been remarked by several ingenious physiologists, that the minute vessels will appear pellucid, even though they may contain the red blood, as the globules will appear pale when solitary in a vessel pervious to one series only \*.

Nor does it appear that the blood in inflammatory cases is impacted in the vessels only, but circumfused into the adjacent cellular cavities ; since if we examine the redness of an inflamed finger

\* Halleri Elementa Physiologiae, Pag. 115.



or membrane, the vessels do not appear in such wise interspersed about the part that colourless spaces intercede between them, as is the case in the eye when irritated; on the contrary, a part inflamed is equably and entirely reddened. Besides, it is repugnant to observation, that an inflammation should succeed to an obstruction: an obstruction in a vessel is a good deal analogous to a ligature, which would impede the free passage of the fluids. But neither obstruction or a ligature have of themselves been productive of inflammation. When the larger arteries have been tied, the umbilical in the new-born foetus, or the carotid, or any other trunk in the living animal, no inflammation has ensued; after a few pulsations and a tumour suddenly coming on, the blood dilates and



circulates through the collateral branches of the artery, and the empty trunk itself collapses, and its sides concrete. In the small and pellucid vessels, in which by the microscope we can detect what is passing, Dr. Haller has observed, that a ligature applied has an effect quite contrary to the received opinion \* ; for the obstructed canals are so far from being distended, that the blood avoids the ligature and the impervious branch, and betakes itself into the communicating arteries, till that which has been tied is left entirely empty. He has likewise had frequent occasion to observe that obstructions have been formed in the small vessels of the liv-

\* Second Memoire sur le Mouvement du Sang, Exp. 54, 93.



ing animal, which were not productive of any ill effects.

We may add, that as the cellular membranes are generally allowed to be the seat of inflammation, it will scarcely seem probable that the vessels interspersed in these fine thin membranes can suffer so great a dilatation, or receive into their cavities such a quantity of blood as would be requisite to constitute the inflammatory tumor; and as it has been proved that the motion of the blood through the minute vessels is extremely languid, and in a good measure depends upon the little oscillatory contractions of the vessels themselves\*, the effects which Boer-

\* Whytt's Physiological Essays.



haave has assigned as consequent upon the circulating blood urged forwards with force upon the obstructed vessels, must of course be void, and without foundation: his whole doctrine likewise of inflammation, as founded upon obstruction, must be deficient; as there must have been a cause for the inflammatory obstruction, and this can only happen from irritation: granting then that obstruction might occasion an inflammation, it must have been the cause of the obstruction, viz. the irritation that would have been productive of the inflammation, and the obstruction would only have been a consequence, but by no means the cause of the disease.

Dr.



Dr. Whytt's theory of inflammation is much more satisfactory than the Boerhaavian ; and he is most certainly right when he attributes to an encreased oscillatory motion of the smaller vessels, excited by a stimulus or irritation, the cause of inflammation ; but it may be doubted, (or indeed, from what has been above observed as to the doctrine of obstruction, it will rather appear improbable) whether the effects he has assigned will be found sufficient, when he supposes that in consequence of the encreased contractions of the vessels, the part will be inflated, and globules of red blood forced into the serous vessels, i. e. an inflammation must be produced.

Will it not appear much more probable, that, agreeable to Haller's ob-



servations, an effusion of blood into the cellular membranes from the extremities of the arteries, which exhale into their cavities, will be brought on by the unusual irritation; and this of all other hypotheses hitherto advanced, should seem to be the least liable to exception, as it best accounts for the several appearances in inflammatory diseases.

From the dilatation of the vessels, and repletion and distension of the cellular follicles, the tense, resplendent, red tumour, even Boerhaave himself, and his commentator Van Swieten, are obliged to allow that the red blood passing into the cellular membranes, is a cause of the tumour in even considerable inflammation,



tion, as the parts could not be so greatly enlarged from an obstruction and distension of the vessels only \*. The acute pungent pain will depend upon the irritation of the nervous fibrillæ, and the distension, compression, and dilatation of the vessels. The pulsation will be owing to the stronger encreased and quickened contraction of the vessels, and the burning heat to this and the consequent accelerated motion and friction of the fluids; the tense pulse, quickened and stronger circulation, and the like, to the increased irritability of the heart and vascular system, and the nervous influence too much determined to the circulating powers.

\* Comment. in Aphorism. 382.



§. 46. It should appear then that no inflammation can subsist without a preceding or concomitant irritation, which alone will always prove sufficient to produce it ; as a thorn lodged in the finger, or a little acrid matter collected below the nail, will frequently bring on a violent inflammation, extending even to the shoulder. By the unusual stimulus the oscillatory contractions of the smaller vessels must necessarily be augmented and excited, and a greater quantity of fluids in a given time must circulate through them : hence from the stronger and more frequently repeated contractions, the force of the blood in the irritated vessels will be greatly increased, the vessels themselves dilated and distended, and those whose orifices open into the cells of the adipose or follicular mem-



membranes, and naturally exhale a thin fluid only, will now suffer the red blood to pass or exude through their extremities into the cellular cavities. That this has been the case is evinced from observation and *αυτοπσία*, as Dr. Haller, in different inflammatory affections which he has had an opportunity of examining after the decease of the patient, has found that the blood has been extravasated into the cellular membranes\*.

§. 47. An encreased force of the blood in the larger vessels does not then seem necessary to constitute an inflammation, yet it is most frequently the consequence of it; for as often as the inflammation is any thing considerable, or the part

\* Opuscul. Patho'ogica Obs.



inflamed very sensible, the whole nervous system will be so affected by the pain as to render the heart and larger arteries more irritable, and their contractions more frequent and strong, whence an encreased circulation and fever.

§. 48. The causes of inflammation may be various according as the disease should be of the external or internal kind. Any thing which is capable of producing an irritation, and exciting the contractile powers of the vessels, may give occasion to an affection of this kind; hence frictions, burns, a foreign substance lodged in the flesh, stimulating, irritating applications, and the like, may readily be productive of these complaints. But as these cannot often  
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subsist in the internal parts and viscera of the body, but are principally confined to the external or extreme parts, we must have recourse to some other principle to explain the causes of our internal, inflammatory, and other acute febrile diseases. These then for the most part will derive their origin from cold: our patients themselves generally remember that they have been exposed to cold, and blame this as the primary cause of their disease.

§. 49. The excretion by the skin, or insensible perspiration, is the last and most elaborate action of animal digestion, and frees the body from what is consequently the most subtle, acrimonious, and putrescent of the animal humours.



mours. It is of the highest concern to the life and well-being of the animal machine; and though it may be excreted, sometimes in a greater, sometimes in a lesser quantity, as influenced by various causes, yet it can never long be partially suppressed, much less entirely obstructed, without the greatest detriment to health, and exciting various disorders in the animal oeconomy, such as catarrhs, rheumatisms, fevers, inflammations, and innumerable other complaints; as from the stimulating acrimony of the excrementitious humours, the circulating powers will be variously disturbed and affected, and the vessels excited to stronger and more frequently repeated contractions. It should seem then that the inflammations of the internal parts will depend upon the irritation



tation and consequent encreased and quickened contractions of the vessels, from a retention of the acrimonious perspirable particles, determined to and infixed in some particular viscus or membranous part. Thus much however we may venture to assert, that though we may not be perfectly acquainted with the secret operations of nature in the formation of diseases, if we attend to experience and observation, we shall find that our inflammatory complaints are originally owing to cold ; and from this principle, and this only, considered as the primary cause of the disease, can the several phenomena preceding and concomitant to internal inflammation be explained and understood.



§. 50. An inflammatory tumor cannot long continue in its state of inflammation, but must within a few days be terminated either by resolution, suppuration, or gangrene. Boerhaave and his followers have supposed that it may sometimes be succeeded by schirrus; but it may be doubted whether a schirrus is ever the consequence of inflammation, perhaps experience will not warrant it.

§. 51. An inflammation is resolved when the irritating cause being expelled or subdued, the increased flow of humours ceases, the effused fluids are absorbed, the distended vessels relaxed, and the circulation through the part becomes regular and equable as before.

§. 52.



§. 52. An inflammation terminates by suppuration, when from an encrease of the symptoms the absorption of the effused fluid is impeded, which by its stagnation will be changed from its natural state, and, together with the cells and their contents, will be dissolved and converted into an homogeneous humour, known by the name of pus.

§. 53. An inflammation is succeeded by gangrene when the mass of fluids in general are tainted with a putrescent acrimony, or the affected part itself, such as the intestines, or the like, from their peculiar nature prone to putrefaction. The irritability of the solids in general will under these circumstances be almost immediately destroyed, the circulation through the part affected will

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cease,



cease, the effused liquors putrefy, the red colour is changed to a livid or blackish hue; the pain, heat, and pulsation are abated; the pulse becomes weak, languid, and scarce perceptible, till at length the circulating powers being no longer able to propel the humours, inevitable death must close the scene.

§. 54. From what has been observed of the several events of inflammation, we shall readily determine which of them is the most eligible and to be wished for; and that its resolution, especially when it happens to an internal part, is by all means to be attempted, as being the safest, and attended with least trouble, danger, and difficulty.

§. 55.



§. 55. That we may procure a resolution of inflammation, our attempt should be directed to reduce to proper bounds the febrile impetus, to remove and enervate the cause of the disease, and allay the encreased oscillatory contractions of the vessels.

§. 56. Every fever is its own cure, all that art can do is properly to regulate the febrile impetus, and provide for the relief of the symptoms: as an inflammation is a partial fever, we shall find that when the cause is removed, the powers of nature rightly moderated will suffice for its own cure: but as in general the patient is plethoric, and the actions of the vessels and impetus of the circulation are greatly encreased in all diseases of this kind; and as by these



means, from the too rapid motion of the fluids and distention of the vessels, the regular secretions and excretions cannot be given off, nor the extravasated fluids absorbed, it will be found an affair of the highest importance to reduce to proper bounds the circulating powers by plentiful and repeated blood-lettings, and other evacuations. And as the most healthy and robust, whose fluids are dense and fizy, and solids strong and elastic, are the most liable to inflammatory diseases; blood-letting will certainly be the first intention for the relief of those symptoms that depend upon a circulation too much excited, and a contractile state of the vessels too much encreased: by this evacuation the quantity of the arterial blood being diminished, the vessels



will become less distended, at the same time are relaxed and their action weakened, the blood itself will be less compressed and more thinned, and its density and inflammatory diathesis resolved; the fever will be abated, the impetus of the circulation diminished, and the powers of life and nature weakened and rendered less active: hence necessarily as the circulation becomes more moderate and regular, an absorption will be more readily made by the depleted and less contracted vessels, and both the general and partial fever will greatly abate. As to the quantity of blood to be drawn, it depends principally upon the strength and constitution of the patient and violence of the disease; but if we attend duely to the pulse and circulating powers, we shall not often err; whilst this continues hard, tense, and full, we may



evacuate to advantage; but if soft, weak, or low, we must desist from a further evacuation.

§. 57. But though blood-letting promises to be so immediate an assistance for the relief of the symptoms in incipient inflammatory diseases, we may observe that it is not so in their advanced state, and perhaps after the fourth or fifth day is rather detrimental than serviceable; for the extravasated fluids, by their stagnation, and perhaps by a slight putrefaction, being altered from their natural, and tending to a purulent state, a resolution will not be obtained; and now it only remains that by a mild suppuration the inflamed parts may be separated from the sound, and this event of inflammation, a fever, and that frequently



quently a smart one attends, whose impetus ought not to be lessened, at least by large and repeated bleedings: but even here, if the fever should run too high, with great heat, and a pulse full and strong, a moderate blood-letting will prove rather useful than disserviceable to promote the suppuration: in general we may lay it down as a rule, that in all inflammatory cases if the pulse should be tense and full, we shall not easily err or do mischief; but on the contrary, greatly benefit the patient by a moderate blood-letting.

§. 58. Though a prudent and proper use of the lancet appears to be so efficacious and necessary in the cure of inflammatory diseases, we are by no means to neglect other assistances; lenient pur-



gatives will frequently be found greatly useful; such are infusions of fenna and rhubarb, solutions of manna, the cathartic salts, cremor tartar, and the like; these may be a means of fusing and evacuating the humours, and gently diverting their impetus to the intestines. But of all other remedies, the preparations of antimony after blood-letting will claim the preference. By these the primary cause of the disease, the obstructed perspiration may be overcome, and the excretion restored, which is an intention of consequence in the cure of inflammation.

§. 59. As our inflammatory febrile complaints are owing to cold, it should seem that if we could promote a perspiration,  
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and excite a gentle diaphoresis, without heating the body or increasing the fever, it must be the most ready and rational manner of relieving the patient, and experience indeed evinces the success of this method of treatment; but our best and almost only remedies for this purpose are prepared from antimony; with these we can with a good deal of certainty promote the excretion from the several outlets. The emetic tartar, which is as good as any of the preparations, may be given, from half a grain to two grains, with a little of the calx of antimony to encrease its bulk, in thin syrup, or the like, at the distance of twenty-four hours for two or three times. Or we may prepare a powder from the regulus crocus or glass of antimony;



timony ; either of these in very fine powder being well mixed with an equal quantity of pulverized nitre, should be injected by a spoonful at a time into a red-hot crucible ; let it be continued in fusion for about twenty minutes after the detonation ceases, when it may be removed from the fire, should be well washed with warm water and finely powdered. It may be given from eight grains to forty. If to half a dram of this powder we add gr. ij. of mercurius corallinus, we shall have a medicine not to be distinguished in smell, taste, or operation from the powder which has lately made so much noise in the cure of fevers, and for which Dr. James has procured his majesty's letters patent. The practice of physick in fevers is  
most



most certainly improved by the introduction of the reguline preparations; and though Dr. James is by no means the first who used and recommended them as a febrifuge, it must be owned that their good effects have been more generally known, and the medicine itself brought more into esteem from the good success which has attended the use of his preparation. And indeed it will readily appear, that after blood-letting they bid the fairest of any medicine to relieve in every internal inflammatory affection; as by their gently stimulating qualities they will promote the several excretions, puke once or twice, frequently procure a stool, and almost always excite a copious sweat without heating the body or encreasing the fever.



ver. We should observe that their use ought principally to be confined to the first days of the illness, as perhaps after the fourth day they will be rather prejudicial than useful; for the retained perspirable particles being changed by their remora in the body, can only be expelled by proper coction and crisis; hence by exciting the evacuations by vomit and stool, we should rather fatigue and weaken, than benefit the patient, as the morbid matter will rarely be expelled at this stage of the disease. Sometimes indeed it may happen, that at the latter end, or after a proper coction of the morbid fomes, if the patient has strength to bear the operation, by promoting the several excretions it may tend to bring on a crisis and hasten the removal of the disease.



§. 60. Diluting antiphlogistic liquors should be plentifully taken, such as barley-water, a decoction of apples, lemonade, watergruel, thin weak whey, and the like.

§. 61. The common saline draught with nitre may generally be given to advantage ; but as the pulse becomes lower the nitre should be omitted, and twelve or fourteen grains of salt of hartshorn substituted in its room ; or towards the latter end of the disease, if the pulse should flag, as is frequently the case, to the sal. corn. cerv. may be added the warm aromatic cordials. The neutral salts we may observe, will frequently excite a sweat, and this perhaps by a gentle stimulus upon the vascular system ;



tem ; but if they should not sufficiently of themselves tend to promote this discharge, we may for the most part effectually answer the intention by adding to each dose thirty or forty drops of the ipecacoanha wine, which, as an attenuant and sudorific, is a medicine that is exceeded by few.

§. 62. It may appear contradictory to prescribe the volatile alkaline salts in a disease where the circulation is already too rapid, and the vis vitæ too much excited ; but after the pulse has been lowered, they will well tend to resolve the inflammation. Dr. Huxham supposes \*, that the volatile salts and spirits

\* Dissertation on the malignant ulcerous sore throat.



hasten the dissolution of the blood whilst under the power of the circulation, and even when mixed with the blood out of the body, or rather as it runs from the vein; they quite destroy the texture of its globules, by dissolving the copula or cohesion of its component particles; even the most sizy blood thus managed never concretes into a solid crassamentum, and throws off its serum, but remains ever after a loose dissolved gore or fanies; nor does he think that the volatile alkaline salts heat the body, by encreasing the projectile force and circulation, so much as by causing an intestine motion and effervescence in the blood; for by the most accurate experiments it is found, that solutions of the volatile alkaline salts weaken the  
tone



tone of the fibres and power of the vessels; consequently the momentum of the blood in the regular course of circulation. Since then the people of plethoric habits, with strong and rigid solids, and a dense sizy state of the fluids are by far the most subject to inflammatory indispositions, will it not follow, that after a prudent use of evacuations, salt of hartshorn would bid fair to dissolve the inflammatory gluten, as well as to weaken the tone of the solids, and lessen the momentum of the blood in the course of the circulation. Experience at least evinces the salutary effects of a prudent and well timed use of this remedy in most inflammatory diseases.

§. 63. But whilst we are insisting upon internal remedies, topical applications



tions to the part affected are by no means to be neglected; hence a particular regard is to be had to the vessels of the diseased part, whose extraordinary contraction should be lessened by proper emollient and anodyne applications, fomentations, cataplasms, and the like; and in many cases by blistering the neighbouring parts. Dr. Pringle has often observed the good effects of blisters, even when early applied, in pleurifies and other internal inflammations†; and though many physicians may have entertained prejudices against blistering in inflammations, because by their irritation they encrease the force of the circulation in general; yet, not to mention the good

† Observations on the Diseases of the Army.



effects they may have by attenuating the inflammatory matter, and making a considerable derivation of ferous humours from vessels which are nearly connected with those of the part affected, if the account that has been given of inflammation be true, it must follow that although the material cause of an inflammation, the acrid or irritating cause, be not immediately removed by blistering, yet if, according to Hippocrates's observation, the painful sensation in the inflamed vessels be lessened by its means, the extraordinary oscillatory motions of these vessels, and consequently the cause continuing and increasing, the inflammation must be also lessened: hence it appears that a  
blister,



blister, though it tends to encrease the force of the circulation in general, may yet lessen the impetus of the blood upon the vessels of an inflamed part, more remarkably than even blood-letting itself. What has been said of blistering may be applied also to cupping and scarifying in pleurisies, anginas, and the like.

§. 64. In general we may observe, that as our internal inflammations are resolved in the same manner as in other fevers, there appears a sensible crisis: if as the symptoms abate, a sweat should break out, and the urine let fall a copious purulent-like sediment, there is the greatest probability of a speedy relief; hence we shall find a great analogy between the partial and general

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fever, and the cure of the one will be greatly illustrated by that of the other.

§. 65. If the inflammation should not be resolved, but come forward to a suppuration, and the part affected cannot be come at, or the abscess laid open, and the ulcer deterged and healed, a variety of bad and dangerous symptoms will ensue, the confined pus will become acrid, irritate, and ulcerate, and a portion of it being absorbed into the circulation by its stimulus will incite the heart and vascular system into quicker vibrations; whence a hectic fever will be induced, the fluids will be dissolved, the solids relaxed, colliquative sweats, and a diarrhæa will come on, and at length, if the purulent fomes cannot be

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cut off, the patient must be exhausted, and will die tabid.

§. 66. Sometimes it may happen, that even after matter is formed under particular circumstances, it shall be again absorbed and received into the circulation, and critically deposited upon some other part of the body ; if the metastasis should be made from the vital or any of the viscera to the extremities, it will prove extremely salutary, and may be a means of effecting a cure : thus sometimes in pleuritic and peripneumonic cases, the disease has been determined from the breast by suppurations and discharges on the legs and extremities ; but if it should be transferred from a less to a more noble part, death will frequently



be the consequence: thus an erysipelas repelled from the face will sometimes attack the brain, and deliriums, phrenzies, and the like, will supervene. Sometimes a peripneumony or inflammation of the lungs has been succeeded by a more dangerous phrenzy; whence Hippocrates has remarked, “a peripneumonia phrenitis malum\*.” The purulent matter in the small-pox being absorbed into the circulation, and deposited upon some of the viscera, will occasion a great many dangerous symptoms, peripneumonies, phrenzies, and the like. Under these circumstances, we should endeavour as much as possible to divert the flow of humours from the more to the less noble parts,

\* Aphorism 12. Sect. 7.



If the pulse should be moderately full and strong, we may make evacuations by blood-letting and stool; afterwards blisters should be liberally applied to the neighbouring parts, and very strongly stimulating applications to the feet, such as poultices of bread and milk, with half an ounce or six drams of bruised mustard-seed. These will frequently remove or lessen ravings, or the other symptoms of a translated inflammation, by determining the flow of humours to the stimulated parts; and at the same time, by raising a considerable pain, which so affects the mind as to render it less sensible of the unusual stimulus or irritation in the affected part; whence frequently the phlogistic matter will be again taken up, and either determined to the extremities, or expelled from the body by



the discharge from the blisters or by urine or sweat.

§. 67. What has been said concerning inflammation, will lead us to an acquaintance with the nature and general method of treatment of an erysipelas, or St. Anthony's fire, which disease should seem to be only an inflammation of the skin, perhaps from some acrimonious particles to be expelled the circulation. By properly moderating the febrile impetus; if too high, by lowering it by evacuations and antiphlogistics; if too low, by raising it by cordials; by applying a blister near the part affected, and emollient fomentations or cataplasms to the inflammation itself, we shall rarely fail of remedying this complaint. We may likewise



likewise understand the nature of the acute inflammatory fever, as its causes and method of cure are greatly analogous to those of the partial fever, and the doctrine of the one illustrated by that of the other.

§. 68. *Have we any certain criterion to distinguish an inflammatory from a disease of another kind?* The heat, throbbing pain and fever will generally suffice to form a diagnosis of inflammation: but the pulse will, for the most part prove an unerring guide, as it will be always quickened, and most frequently full, hard and tense; if this should not be quicker than common, we may be convinced that the disease is not inflammatory. In some cases, where pains in different parts of the body have been excessively



cessively acute, as in the side, back, stomach, and the like, the pulse has neither been quickened nor harder or fuller than natural; under which circumstances there has been no difficulty to determine that the disease could not depend upon inflammation, but has generally been owing to a spasmodic, or a periodical cause. In most inflammations then, the pulse will be quickened, become fuller and more tense, though, as an exception to the fullness and hardness of the pulse it has been remarked, that in inflammations of the stomach, guts and uterus, the pulse, though much quickened, often continues small; because, according to Dr. Whytt, on account of the particular sympathy between their nerves and those of the



heart, this muscle is rendered so irritable as to contract before its ventricles are filled with the returning venous blood \*.

§. 69. *Have we any rules to judge when an inflammation verges to suppuration, or when there may ensue a disposition to gangrene?* It has been supposed that we may judge of the suppuration of an inflammatory tumor by the frequent and involuntary shiverings the patient shall be attacked with: but if a mortification should have supervened, the pulse will immediately sink, and become scarcely perceptible; cold sweats and a general languor will succeed, the preludes to an approaching dissolution and inevitable death.

\* Physiological Essays, Page 67.



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T H E  
**CONCLUSION.**

§. 70. **W**E have hitherto been examining the effects of blood-letting, the intentions of cure it can answer, and the diseases it should be recommended in: it remains to enquire into the ill consequences that may succeed to its injudicious use, and point out the circumstances which forbid the evacuation. And these indeed are many, which in practice are strictly to be attended to, lest by its indiscriminate use it should prove of more detriment than real service in the cure of diseases.



§. 71. From what has been above observed as to its effects, we shall easily judge under what circumstances it can be prejudicial ; for as it can only act by attenuating the fluids and weakening the circulating powers, it will readily appear, that where the fluids are already too thin, or the circulation and action of the vessels too languid, blood-letting can be of no advantage, but on the contrary may greatly hurt : a few hints then as to the impropriety of the evacuation under particular circumstances may, it is presumed, be of service to the young practitioner, to whom opportunities of remarking the effects of different remedies in different diseases may not frequently have occurred.



§. 72. And first, it may happen that even in inflammatory diseases, especially when they have been of some days continuance, blood-letting may prove injurious; for if the pulse, instead of being full, high, and tense, should be low, weak, and soft, it will be expedient to excite rather than lower the *vis vitæ*; and cordials in this case will be the best remedies to resolve the inflammation.

The truth of this has been frequently remarked in pleuritic, peripneumonic, and other inflammatory complaints, where the cooling methods have been too far insisted on: the powers of nature and the circulation being too much weakened, the inflammatory cause could not be duely concocted or critically expelled  
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the body ; sweat, expectoration, and the other salutary excretions have been checked ; convulsions, deliria, and the symptoms of the low nervous fever have come on ; and without nature can be properly supported by the warm and generous medicines, she inevitably sinks under the weight of the disease.

§. 73. In fevers great caution and judgment are required to bleed with safety ; as innumerable patients have been destroyed by an injudicious use of the evacuation. In large cities, and London in particular, the febrile diseases will not in general require the lancet, as they mostly verge either upon the low nervous, or the putrid kind ; consequently are to be attempted by cordials, and not by antiphlogistics. In the country,  
where



where the inhabitants are generally more robust and plethoric, as their fevers are for the most part of the inflammatory kind, evacuations will become necessary, lest the symptoms should run so high as to prove immediately injurious to life; but in truth, in London we must not be too free with the lancet, as great inconveniencies will ensue. It is to be feared, that the practice is in much more general use than of general advantage.

§. 74. In the diseases from a weakened and a relaxed state of the solids; such as dropsies, leucophlegmatæ, cachexies, fluor albus, hysterical and hypochondriacal affections and nervous complaints in general; blood lettings are manifestly injurious, and contradict



the general intentions of cure; as in these cases the blood is for the most part much attenuated and dissolved, and the actions of the vessels too weak and impaired.

§. 75. In the diseases from a spontaneous gluten, or a pituitous lentor in the vessels and viscera, blood-letting can be rarely required; as in general they owe their origin to a weak state of the primæ viæ, or to a weakened circulation from too rigid a state of the vessels, the effects of age; and as these are maladies that are not to be remedied by an evacuation of this kind, it is certainly unnecessary to exhaust the blood and strength of the patient in any case where we can propose so little advantage; and hence in the pituitous apo-

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plexy, and its usual consequence, the  
 hemiplegia or palsy ; as well as in the  
 jaundice and all other diseases from vis-  
 cidities, we rather hurt than benefit the  
 patient by drawing away blood. Even  
 in the peripneumonia notha or humoral  
 Asthma, provided there should be no  
 tendency to inflammation, or indeed in  
 consumptive coughs, it is much to be  
 doubted whether those advantages are  
 to be reaped from blood-letting as have  
 been generally imagined, at least my  
 own observations have not convinced  
 me of it ; for though I can readily grant  
 that the respiration has been easier and  
 freer for some hours after the operation,  
 which indeed must necessarily follow  
 from a depletion of the vessels in ge-  
 neral, of consequence of the lungs like-  
 wise ; yet in a day or two the dyspnæa  
 will



will return with aggravated violence, frequently attended with swelled legs and other symptoms, from an impoverished state of the fluids. Nor does it appear that frequent blood-lettings in a confirmed consumption are of that service we should be induced to believe from so great an authority as that of Dr. Mead; as for the most part they only tend to weaken the patient, and hasten him to his end.

§. 76. In the diseases from a putrescent acrimony or spontaneous putrefaction of the humours, such as the scurvy, and the like, an evacuation of blood will be manifestly prejudicial, and can answer no good purpose.

§. 77.



§. 77. In short, in all cases from a relaxed state of the solids, a dissolved state of blood, and a weak, languid circulation, blood-letting must be avoided, as encreasing all the symptoms, and contrary to all the intentions of cure.

F I N I S.



















Smith, Hugh

Essays physiological and practical on the nature and circulation of the  
Blood and the effects and uses of Blood-Letting

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